A Multilevel Approach to Model Weight Gain: Evidence from NLSY79 Panel

Bidisha Mandal
Washington State University

bmandal@wsu.edu
Obesity Trends* Among U.S. Adults
BRFSS, 1985

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1986

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1987

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1988

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1989

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1990

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1991

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1992

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1993

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1994

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1995

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1996

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1997

(*BMI $\geq 30$, or $\sim 30$ lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1998

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 1999

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 2000

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 2001

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 2002

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2003

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 2004

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 2005

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Obesity Trends* Among U.S. Adults
BRFSS, 2006

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: CDC-BRFSS
Role of Economics

- Choice of variables, datasets
- Hypotheses testing
- Type of Model
- Estimation
- Interpretation
- Capture trends, group effects
- Cost-benefit analysis
Economic Studies

- Chou, Grossman, Saffer (2004) - increase in per capita number of restaurants, decrease in food prices, increase in cigarette prices

- Kuchler, Variyam (2003) - lack of nutritive information on food sold at restaurants and fast-food establishments, public perceptions of appropriate weight

- Cutler, Glaeser, Shapiro (2003) - technological innovations that reduce time cost of food

- Philipson (2001) - increasing value of women’s time in labor market

- Ploeg, Mancino, Lin (2006) - food stamps

- Klesges, Klesges (1988) - smoking cessation

- Ruhm (2002) - countercyclical variation in physical health
Other Studies

- Power, Parsons (2000) – Nutrition in infancy and childhood, psychological factors, cultural or social norms regarding dietary restraints and attitudes to fatness as explanations to adult obesity

- Vaidya (2006) – Treatment of depression in obesity; bias and stigma associated with obesity

- Puhl, Brownell (2003) – Social and psychological origins of weight bias

  - Stigmatization
  - Prevention
Motivation

- Obesity is a function of both state level and individual level characteristic

- Most individuals in the age group of 31-47 earn wages (90% men, 80% women in present sample)

- Earnings play a definitive role in our choice of lifestyle
  - Earn wages to buy food, perhaps gym membership too
  - Being unemployed or being out of labor force provides more time to invest in healthy lifestyle, but is it affordable?
Model

- Non-negative weight gain is (primarily) a function of earnings
  - Establishing causality
  - Initial weight matters

- Food stamp participation further reveals the heterogeneity in earnings
  - Wage earners could be participants – e.g. a family of four whose net total monthly income is $1,721 is eligible (as per 2008 requirement)
  - Among participants, a small wage increment might render them non-eligible

- Multilevel Linear Model
  - Individuals are nested within states – Hierarchy
  - State level covariates can improve model and still give accurate estimates
Data

- **Individual level**
  - National Longitudinal Surveys (start year 1979)
  - Panel data – 1994 to 2004, unbalanced
  - Demographics, Income, Wages, Marital status, Weeks employed, Food stamps participation
  - State of residence
  - Genders analyzed separately
    - Men (49.4% → 4255); Women (50.6% → 4354)
  - Weight Response rate
    - Weight – 99.3% men, 96.1% women
    - Income – 82% men, 81.6% women
    - Wages – 95.2% men, 94.4% women (including those who did not earn wages)

- **State level**
  - Cigarette tax
  - Gas prices
## Age Distribution – Average Weight Gain

<table>
<thead>
<tr>
<th>Age</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>14.2 (1.5%)</td>
<td>19.1 (1.2%)</td>
</tr>
<tr>
<td>32</td>
<td>12.3 (4%)</td>
<td>13.9 (3.3%)</td>
</tr>
<tr>
<td>33</td>
<td>13.6 (6.1%)</td>
<td>15.7 (4.6%)</td>
</tr>
<tr>
<td>34</td>
<td>13.9 (7.3%)</td>
<td>15.9 (6.8%)</td>
</tr>
<tr>
<td>35</td>
<td>15.7 (8.1%)</td>
<td>17.1 (7.6%)</td>
</tr>
<tr>
<td>36</td>
<td>15.5 (9.7%)</td>
<td>17.3 (9.5%)</td>
</tr>
<tr>
<td>37</td>
<td>14.6 (9.4%)</td>
<td>19.9 (9.6%)</td>
</tr>
<tr>
<td>38</td>
<td>15.7 (10.6%)</td>
<td>17.2 (10.9%)</td>
</tr>
<tr>
<td>39</td>
<td>15.2 (9.2%)</td>
<td>16.8 (8.8%)</td>
</tr>
<tr>
<td>40</td>
<td>16.8 (8.7%)</td>
<td>17.4 (9.5%)</td>
</tr>
<tr>
<td>41</td>
<td>16.5 (7.4%)</td>
<td>18.2 (7.6%)</td>
</tr>
<tr>
<td>42</td>
<td>17.4 (6%)</td>
<td>18.1 (6.4%)</td>
</tr>
<tr>
<td>43</td>
<td>17.8 (4.7%)</td>
<td>18.6 (4.8%)</td>
</tr>
<tr>
<td>44</td>
<td>18.8 (2.8%)</td>
<td>17.6 (3.5%)</td>
</tr>
<tr>
<td>45</td>
<td>20.7 (2.2%)</td>
<td>18.7 (3.2%)</td>
</tr>
<tr>
<td>46</td>
<td>18.9 (1.2%)</td>
<td>19.6 (1.5%)</td>
</tr>
<tr>
<td>47</td>
<td>15.3 (1%)</td>
<td>13.6 (1.2%)</td>
</tr>
</tbody>
</table>
# Race – Average Weight Gain

<table>
<thead>
<tr>
<th>Demographic variable</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic</td>
<td>16.5 (18.8%)</td>
<td>15.7 (19.5%)</td>
</tr>
<tr>
<td>African American</td>
<td>17.6 (30.8%)</td>
<td>20.8 (30%)</td>
</tr>
<tr>
<td>Non-African American, Non-Hispanic</td>
<td>14.3 (50.4%)</td>
<td>16.2 (50.5%)</td>
</tr>
</tbody>
</table>
Education – Weight Gain

**Distribution of Weight Gain by Education Men**

**Distribution of Weight Gain by Education Women**
### Variable of Interest – Respondent’s Body Weight

<table>
<thead>
<tr>
<th>Variable (within consecutive waves)</th>
<th>Median (Standard deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
</tr>
<tr>
<td>Maximum weight gain (lb)</td>
<td>15.7 (14.2)</td>
</tr>
<tr>
<td>Any weight gain (lb)</td>
<td>8.08 (10.8)</td>
</tr>
<tr>
<td>North Dakota, Nebraska</td>
<td>7.5 (6.6)</td>
</tr>
<tr>
<td>Delaware, Mississippi</td>
<td>30 (14.8)</td>
</tr>
</tbody>
</table>

- 106 men (2.5%) and 118 women (2.8%) reported more than 50 lb weight gain within two years
- 211 men (5%) and 141 women (3.4%) reported no weight gain within two years
- For Washington State, the median maximum weight gain for women is 17.1 lb (std=15.1) and for men is 15.4 lb (std=12.6)
Graphs – Maximum Weight Gain

Max Wt Gain among Men in NLSY79

Max Wt Gain between Consecutive Waves

Frequency

Max Wt Gain among Women in NLSY79

Max Wt Gain between Consecutive Waves

Frequency
Graphs – Weight Gain

**Weight Gain among Men in NLSY79**

**Weight Gain among Women in NLSY79**
## Wage Status

<table>
<thead>
<tr>
<th>Transitions in Wage Status</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Started earning wages</td>
<td>3.2%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Stopped earning wages</td>
<td>4.4%</td>
<td>6.6%</td>
</tr>
<tr>
<td>Continued to not earn wages</td>
<td>6.2%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Continued to earn wages</td>
<td>86.2%</td>
<td>75.7%</td>
</tr>
</tbody>
</table>
## Food Stamps Participation

<table>
<thead>
<tr>
<th>Transitions in Food Stamps Status</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stopped receiving food stamps</td>
<td>3.2%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Started receiving food stamps</td>
<td>2.2%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Continued to receive food stamps</td>
<td>3.9%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Continued to not receive food stamps</td>
<td>90.7%</td>
<td>81%</td>
</tr>
<tr>
<td>Change in Wages</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>- $10,001</td>
<td>8.3%</td>
<td>5.9%</td>
</tr>
<tr>
<td>- $10,000 to - $1,000</td>
<td>13.3%</td>
<td>15.5%</td>
</tr>
<tr>
<td>- $1,000 to + $1,000</td>
<td>10.5%</td>
<td>13.6%</td>
</tr>
<tr>
<td>+ $1,000 to + $10,000</td>
<td>34%</td>
<td>38.2%</td>
</tr>
<tr>
<td>+ $10,000 to + $20,000</td>
<td>14.1%</td>
<td>10.2%</td>
</tr>
<tr>
<td>+ $20,001</td>
<td>11.6%</td>
<td>6%</td>
</tr>
<tr>
<td>Missing</td>
<td>8.2%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>
State Level Data

<table>
<thead>
<tr>
<th>Proportionate increase (new-old)/old</th>
<th>Mean (SD)</th>
<th>Min, Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>in Gas Price</td>
<td>0.19 (0.36)</td>
<td>-0.28, 0.89</td>
</tr>
<tr>
<td>in Cigarette Tax</td>
<td>0.16 (0.26)</td>
<td>-0.06, 1.34</td>
</tr>
</tbody>
</table>

- Due to small cell counts Maine, New Hampshire, Rhode Island, Vermont, District of Columbia, Idaho, Utah, Wyoming, Alaska and Hawaii were dropped.
- Based on state level similarities, some responses were merged to achieve higher cell counts.
  - Kentucky and Mississippi
  - Delaware and Maryland
  - Iowa and Missouri
  - Kansas, Nebraska and South Dakota
  - North Dakota and Minnesota
Results – Wage status

- Women
  - Transition from not earning wages to earning or vice versa has no effect, but those who continued to be out of labor force on an avg. gained 2.4 lb compared to those who continued to earn wages
  - Doubling cigarette taxes would cause 1.8 lb increase on an avg.

- Men
  - Transition matters – those who started earning wages on an avg. gained 2.5 lb, those who stopped earning wages on an avg. gained 7.2 lb and those who continued to be out of labor force on an avg. gained 5.5 lb compared to base group
  - Doubling gas prices would cause 1.1 lb increase on an avg.
  - Doubling cigarette taxes would cause 2.2 lb increase on an avg.

- Other results
  - Heavier individuals are more likely to gain weight
  - An extra year of schooling is associated with 0.4 lb lesser weight gain among both men and women
Results – Wage Differences

- **Absolute wage**
  - 3 categories – less than $35k, $35k-68k and more than $68k wages earned in past year
  - Women in the lowest wage category on an avg. gained 4.3 lb more and in the middle category gained 3.4 lb more than ones in the highest category
  - Men in the lowest wage category gained 1.8 lb more than ones in the highest category

- **Change in wage**
  - 6 categories – - $10k or greater loss, - $10k to - $1000, - $1000 to + $1000, + $1000 to + $10k, + $10k to + $20k, +$20k or greater gain
  - Individuals in the wage change category $1000 to $10k exhibited 0.8lb lesser weight gain.
Results – Food Stamps

- **Women**
  - Transition matters – those who stopped receiving food stamps on an avg. gained 3.5 lb, those who started receiving food stamps on an avg. gained 5.4 lb and those who continued to receive food stamps gained 2.3 lb on an avg. compared to base group.
  - Doubling cigarette taxes would cause 1.6 lb increase on an avg.

- **Men**
  - Transition matters but not as much – those who started receiving food stamps gained 3.1 lb on an avg. and those who continued to receive food stamps gained 2.5 lb on an avg. compared to base group.
  - Doubling gas prices would cause 1.2 lb increase on an avg.
  - Doubling cigarette taxes would cause 2.1 lb increase on an avg.

- **Other results**
  - Heavier individuals are more likely to gain weight.
  - An extra year of schooling is associated with about 0.4 lb lesser weight gain among both men and women.
Results – Participation in Labor Force

- **Women**
  - A $10,000 increase in wages for those who started receiving food stamps causes a 5.8 lb weight gain on an avg.
  - Doubling cigarette taxes would cause 2.3 lb increase on an avg.

- **Men**
  - No interaction effect of wages and food stamps on weight gain
  - Compared to those continuing to earn wages, those who started earning wages gained 2.8 lb more on an avg.
  - Doubling cigarette taxes would cause 2.6 lb increase on an avg.

- **Other results**
  - Heavier individuals are more likely to gain weight
  - An extra year of schooling is associated with about 0.3 lb lesser weight gain among both men and women
Implications

- Role of economic status
  - Those transitioning in and out of labor force are more susceptible
  - Being out of labor force does not coincide with healthier life style
  - Food stamps participation reveals heterogeneity within wage earners

- Gender inequalities
  - Even when same factors affect both groups, magnitudes differ

- Cigarette taxes
  - A higher tax could motivate many to quit smoking, which itself could adversely affect weight
Data Issues

- Limitations of public use data files
- Need more lifestyle variables
- Need more policy variables
Prevention, Intervention – NIH guidelines

- Treatment
  - Assessment and classification
  - Assessment of risk status
  - Evaluation and treatment strategy

- Therapies
  - Dietary therapy
  - Physical activity
  - Behavior therapy
  - Pharmacotherapy
  - Weight loss surgery

⇒ Scope for collaborative work